Vapor Cooled Structure MLI: Efficient Vapor Cooling of Structural Elements, Phase II

Completed Technology Project (2016 - 2019)

Project Introduction

Human exploration requires advances in propulsion for transport to Earth orbit, the moon, Mars and beyond. New technologies are needed for advanced in-space propulsion systems to support exploration, reduce travel time, reduce acquisition costs and reduce operational costs. The goal is a breakthrough in cost and reliability for a wide range of payload sizes and types supporting future orbital flight vehicles. Lower cost and reliable space access will provide significant benefits to civil space (human and robotic exploration beyond Earth as well as Earth science), to commercial industry, to educational institutions, for support to the International Space Station National Laboratory, and to national security. NASA?s Technology Roadmaps call Zero Boil Off storage of cryogenic propellants for long duration missions? the #2 ranked technical challenge for future NASA missions, and new technologies are necessary for improved cryogenic propellant storage and transfer to support NASA's exploration goals. Heat leak through tank mounts such as struts and skirts is an increasingly large part of the total heat flow into modern, well insulated tanks. Specifically, NASA has a high priority for simple mass efficient techniques for vapor cooling of structural skirts (aluminum, stainless, or composites) on large upper stages containing liquid hydrogen and liquid methane (can include hydrogen catalyst). Improved cryogenic insulation that can incorporate vapor cooling to reduce the heat flux through struts and skirts would benefit cryogenic fluid management, and help towards achieving zero boil off.Vapor Cooled Structure MLI (VCSMLI) is a novel system that uses discrete spacers to create a sealed vapor layer within IMLI for lightweight, efficient vapor cooling of tank skirts. In the Phase I program, VCSMLI was modeled, designed, fabricated, installed on a tank skirt and its thermal performance measured. VCSMLI provided a 41% reduction in total system heat flux reaching TRL 4.

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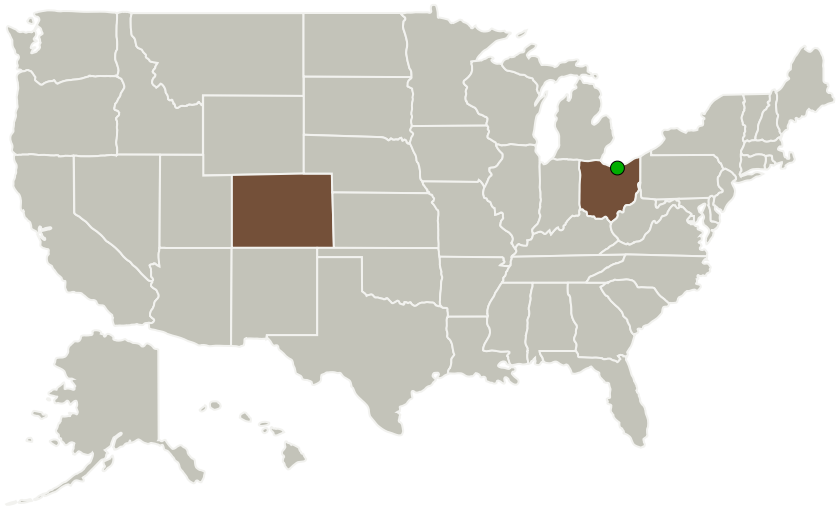
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Quest Thermal Group	Lead Organization	Industry	Arvada, Colorado
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Colorado	Ohio

Project Transitions

April 2016: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139551)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quest Thermal Group

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Scott A Dye

Co-Investigator:

Scott Dye

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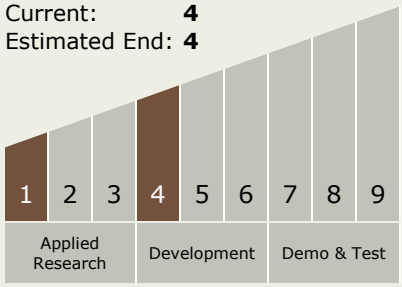
Images

Briefing Chart Image
Vapor Cooled Structure MLI: Efficient Vapor Cooling of Structural Elements, Phase II
(https://techport.nasa.gov/image/137045)

Final Summary Chart Image
Vapor Cooled Structure MLI: Efficient Vapor Cooling of Structural Elements, Phase II
(https://techport.nasa.gov/image/126926)

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.1 In-space Propellant Storage & Utilization

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System